OREGON CAVES NATIONAL MONUMENT
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY

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Executive Summary

A Geologic Resources Evaluation scoping meeting for Oregon Caves National Monument was as held in Ashland, Oregon, March 4, 2004. The scoping meeting participants identified the following as the most significant geologic resources management issues.

1. Slope failure - Landslides and debris flows present the major geologic issue, slope failure, in the park. NPS structures have been lost due to slope failure.

2. Cave and karst - Protection, preservation, restoration, and interpretation of cave and karst are of primary importance to the park.

3. Paleontology - Vertebrate fossils of national importance are found in ORCA. The preservation and interpretation of both vertebrate and invertebrate fossils is of high importance.

Introduction

The National Park Service held a Geologic Resources Evaluation scoping meeting for Oregon Caves National Monument (ORCA) in Ashland, Oregon, Thursday afternoon, March 4, 2004. The purpose of the meeting was to discuss the status of geologic mapping in the park, the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering ORCA; (2) An updated and verified bibliography; (3) Scoping summary (this report); and (4) A Geologic Resources Evaluation Report which brings together all of these products.

Oregon Caves National Monument was established July 12, 1909, under the U.S. Forest Service, specifically to protection the cave system. The legislation states that "...certain natural caves, known as the Oregon Caves...are of unusual scientific interest and importance, and it appears that the public interests will be promoted by reserving these caves with as much land as may be necessary for the proper protection thereof, as a National Monument." It was transferred from the Department of Agriculture to the Department of the Interior, National Park Service, on August 10, 1933. In February 1992, a large portion of the developed area in the monument was listed in the National Register of Historic Places. Total area of ORCA is 487.98 acres.

Oregon Caves lies entirely within the Oregon Caves 7½' topographic quadrangle map. However, the park indicated that three adjacent quads are quadrangles of interest: Kerby Peak, Williams, OR, and Grayback Mountain. Also, the Cave Junction topographic quadrangle, two quads west and one north of Oregon Caves is also a quad of interest. A published geologic map accompanies USGS Water-Resources Investigations Report 83-4100 at a scale of 1:3500. This map will be digitized by the Geologic Resources Division. John Roth, Natural Resources Specialist at ORCA, and Len Ramp have an unpublished digital map that covers the park. A student from Edinburgh, Scotland, produced a digital geologic map as part of a senior thesis. The map covers part of the area of the proposed park expansion. The map was completed in 2000 but the park has not yet seen it. It is proposed that a Geoscientist-in-the-Park (GIP) complete the geologic mapping which should only take a season.

The Cave Junction quad is covered by a 1:96,000 scale map (1949) published by the Oregon Department of Geology and Mineral Industries and also by a USGS Miscellaneous Field Investigations Map, MF-38 (1955), at a scale of 1:250,000. These maps are not digitized. According to Tom Wiley with the State of Oregon, Oregon has done some mapping in the area and has a grant to digitize the maps in the area of Oregon Caves. This effort should also eliminate some discrepancies and overlaps in older maps. The main point of the study is to look at the groundwater resources in Illinois Valley. This work should be completed within about two years.

There is 1978 soil survey for Josephine County that is of good quality and already in the NRCS database. The current NRCS soils database is in MS ACCESS format and contains the link to ecological site descriptions, although they are not actually contained in soil surveys. The mapping is detailed enough to depict where soils developed in serpentine parent materials such as colluvium and/or residuum. Map unit descriptions and Taxonomic Unit descriptions are the sources to look at for this information, and are available in the MS ACCESS database. There is some soil sample information obtained by a former GIP. There also is some vegetation data from work done by Jim Agree.

There is a need for more and better mapping of landslides and debris flows. The 1983 USGS WRI map shows a major debris flow that occurred in 1964 from a rain-on-snow event. More and better information is now available to develop better models using data on water holding capacity, permeability, and soil depth as well as climatic data. Newer models may help predict future debris flow events. The 1964 event is used as an evacuation threshold.

Physiography

Oregon Caves National Monument lies in Siskiyou Mountains in the northwest part of the Klamath Mountains physiographic province. The boundaries of the province are not well defined. According to Irwin (2003), the Klamath Mountains extend from about 43º north latitude (near the Umqua River in Oregon), south to about 40º15’ (North Fork of the Eel River) a distance of about 190 miles. In northernmost California and southwestern Oregon, the Klamaths are bounded on the east by the Cascade Range. The province covers a total area of about 11,800 square miles (Irwin, 1966). The area of the monument comprises the upper portion of the Cave Creek watershed which drains into the Illinois River and then into the Rogue River. The elevation of the Visitor Center is about 4,000 feet.

The Klamath Mountains have been cut by several rivers to form distinct mountain ranges. In Oregon the Klamaths are drained by the Rogue and Smith Rivers. The principal ranges are the Siskiyou Mountains extending from Northern California into Oregon and the Trinity Mountains to the south in California. The highest point in the Klamaths in Oregon is Mt. Ashland at 7,530 feet. General elevations range from 2,000 to 5,000 feet in Oregon. The topography is rugged and steep.

Geologic History

The Klamath mountains are composed of a series of accreted terranes with rocks ranging in age from Cambrian to latest Jurassic (Irwin, 1997). The distribution of rocks in the Klamath Mountains are divided into four roughly arcuate belts reflecting this accretion of terranes. From east to west they are: (1) the eastern (Paleozoic) Klamath belt; (2) the central metamorphic belt; (3) the western Paleozoic and

Triassic belt, and (4) the western Jurassic belt (Irwin, 1966). The belts are separated by thrust faults. The eastern Klamath belt is comprised of an essentially homoclinal sequence dipping to the east and terminating with some deformation against ultramafic intrusive rock. In aggregate the sediments are 40,000 to 50,000 feet thick and range in age from Ordovician to Jurassic, although the Ordovician and Silurian rock are limited to exposures in an isolated northern part of the belt.

In Oregon only the western Paleozoic and Triassic belt and the western Jurassic belt are present. The western Paleozoic and Triassic belt includes the Applegate Group which contains the marble from which the caves at ORCA were formed. The western Jurassic belt includes the Rogue and Galice Formations (Baldwin, 1976). Hotz (1971) described schists beneath thrusts ("Schists of Condrey Mountain") as two main types: a graphitic quartz-muscovite schist and an actinolite-chlorite schist.

Stratigraphy

The schists are believed to range from Paleozoic to Triassic age. The Late Triassic Applegate Group consists mainly metasedimentary and metavolcanic rock. Above the Applegate, is the Late Jurassic Rogue Formation consisting of flow, agglomerates, and tuffs metamorphosed to greenstone, about 15,000 feet thick along the Rogue River. This grades upward and interfingers with the Galice Formation which lies east of the Rogue Formation and is in fault contact with the Applegate Group (Baldwin, 1976). The Galice Formation is composed of a lower metavolcanic unit and an upper metasedimentary unit. The metavolcanic unit is composed mainly of meta-andesite flows and breccias and may be over 7,000 feet thick (Irwin, 1966). The metasedimentary part may be over 15,000 feet thick. The Dothan Formation is probably younger than the Galice, but the Galice was apparently thrust over Dothan Formation. The Dothan is composed of about 18,000 feet of greywacke, dark gray siltstone, volcanics, chert and conglomerates. Likewise, the Otter Point is a mélange consisting of thin-bedded sandstone and siltstone intermixed with blocks of sandstone, pillow lavas and breccia, chert and blueschist believed to be a facies of the Dothan.

Above the Galice and Dothan Formations, the Myrtle Group was deposited in basins during the Nevadan Orogeny, Late Jurassic to Early Cretaceous. Formations in the Myrtle include the Riddle and Days Creek Formations, the Humbug Mountain Conglomerate, and the Rocky Point Formation. The conglomerate is probably the equivalent of the Riddle Formation and the Rocky Point equivalent to the Days Creek (Baldwin, 1976). Fossil clams (*Buchia*) and ammonites have been found in these formations. Most are sandstones, siltstones and conglomerates. The Middle Cretaceous Hornbrook ("Chico") Formation is derived from some of the strata below, also composed of sandstone, siltstone, and conglomerate. The Late Cretaceous is represented by the Cape Sebastian Sandstone (800-900 feet thick) and the Hunters Cove Formation (siltstone, 700-1,000 feet thick). Most of the Tertiary formations are exposed along the coast and include mostly siltstones, sandstones and conglomerates.

Applegate Group

The Applegate Group is of particular interest because the caves of ORCA developed from the dissolution of the carbonates in this group. The group outcrops from the Oregon border north along the upper Applegate River to the South Fork of the Umpqua River. The beds have been folded and metamorphosed producing a series of metavolcanic and metasedimentary rock that strike north to northeast and dip steeply to the east. There may be several thousand feet of volcanics, argillite, metagraywacke, chert, quartzite, and marble.

Imprinted over the low grade (greenschist facies) regional metamorphism is more localized contact metamorphism. The original limestone was metamorphosed into marble by the intrusion of quartz diorite dikes and plutons during the Late Jurassic. Garnet, biotite, and actinolite are present near the contact of the limestone with the intrusive (NPS, 2002). Fractures between major faults, combined with the strike of the original bedding, and a steep hydraulic gradient resulted in the influx of groundwater and consequent dissolution of the marble. The cave system formed mostly underwater in a subsurface stream as evidenced by flow structures such as stream piracy, flood bevels and terraces. There are a variety of structures, features, and clastic materials including breccias, dikes, sills, faults, joints, slickensides, stylolites, a variety of speleothems, rills, sinks, hoodoos, talus conglomerates, bedded silts, volcanic ash, and flowstone. Although most of the cave is formed of calcite, there are occurrences of clay vermiculations, gypsum crusts, argillite and chert layers, and possible aragonite crystals (NPS, 2002).

Significant Geologic Resource Management Issues in Oregon Caves National Monument

1. Slope Failure

The combination of steep slopes, high rainfall, and an erodible bedrock has resulted in frequent occurrences of landslides and debris flows. A ranger station has been lost to slope failure and the park chalet and visitor facilities sit in a narrow valley, potentially in the path of a debris flow. The Federal Highway Administration installed pylons to prevent cracking of the parking lot, but the cracking continues. Slope failures do not appear to be triggered by seismic activity, but rather from heavy rainfall and snowmelt especially in areas denuded by forest fires. There is a need for better mapping of debris flows and to identify areas of potential slope failure.

2. Cave and karst

The monument was set aside to protect the cave and karst system. Major issues are: entrance modifications, restoration of original airflow regimes, effects of fire suppression on the caves, and soil and sediment compaction from cavers and visitors. Historical records seem to conflict regarding the original cave openings. The park would like to restore the original cross sections but without harming the bat habitat. Efforts are also underway to restore the original airflow regime that has been altered by development of the caves.

Fire suppression has resulted in growth of shrubs and small trees near the cave. This additional growth takes up surface water thereby reducing the natural flow of water into the cave. One possible method to study this is by using prescribed burns to remove vegetation and then compare the burned areas to unburned areas. The impact of soil compaction on the caves must be studied. Soil compaction by foot traffic impacts soil microbes, infiltration rates, and the amount of runoff. Mitigation of continuing soil compaction may require the modification of caving routes. Pete Biggam, NPS-NRID, is working with Deana DeWire Physical Science Tech at the monument, on a soil compaction study within the cave, providing technical assistance on determining changes in soil bulk density, as well as what tools can be used to facilitate this. Deana would like to develop sampling procedures and methodologies to measure changes in soil bulk density, infiltration rates, and moisture content. Also, there is a need and desire by the park to work more closely with the Cave Research Foundation on these issues.

3. Paleontology

Besides preserving the cave and karst system, another major issue is preserving and protecting the paleontological resources. There are over 50 paleontological sites with vertebrate bones, mostly amphibians and terrestrial mammals such as jaguar and bears. The park has the oldest bones of grizzly bear in the Western hemisphere. Ages are generally Late Pleistocene to Holocene. Rubble piles from excavation of the caves in which a human tooth was found have been targets of fossil theft and vandalism. There is an interest in studying the fossil pollen in sediments as well as to study crinoids in argillite sections of the cave system. There is also a need to obtain radiolarian age dates. Paleo-climatological studies, such as the temperature of caliche solubility, are being initiated by Peter Clark at Oregon State University. The park is seeking funding through the NRAC. Proposals should be sent to Marsha Davis at the Columbia Cascades Support Office.

4. Other Issues

> Aeolian Processes: There are wind blown deposits (loess) in the cave needing research and interpretation. Some of these deposits are derived from local stream sediment.
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> Wetlands: All wetlands in the park are adjacent to streams. Deana DeWire is developing a wetlands inventory which must now include wetlands in the proposed expansion area. Also, there are cirque lakes in the expansion area. About 3,300 acres is proposed for addition to ORCA. There is concern regarding climate change drying up riparian corridors and meadow communities. Beavers that help maintain wetlands by preventing tree encroachment depend upon these wetlands to remain wet. If they dry up the beavers may go elsewhere allowing trees to populate these areas thereby changing the character of the wetland.
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> Fluvial Processes: There are two artificial ponds in the park which are classified as historic. There is a need to gather data on stream morphology. The U.S. Forest Service is conducting stream morphology studies in areas adjacent to the park.
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> Groundwater: Climate studies indicate that more winter precipitation is falling as rain rather than snow and that summers are dryer. The result is a lower snow pack and more surface flow, leading to an increase in runoff and flash flooding. Groundwater used for public consumption is pumped from a different drainage and is piped by a system that is an old CCC project. This raises concerns that changes in the water table could result in a bloom of brown algae which is harmful to the Port Orford cedar. Also, there is a need to monitor the groundwater budget in the general area and the caves in particular.
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> Soils: There is some occurrence of swelling clays and serpentine soils in the park. The areas are small and current soils mapping does identify some of the serpentine areas. There is a need for more information regarding the location, extent, and plant communities on these soils. Studies

are needed regarding the effects of prescribed burns, wildfires, and fire suppression on soils. A soil mycorrhizal study is also needed.

Geological Interpretation: A new Visitor Center is in progress allowing the opportunity to develop geological exhibits. An aplite dike exposed in the caves should be interpreted. Glacial features in ORCA should also be interpreted. There is an ongoing effort by the park to develop a publication on the park by 2009, the 100th anniversary of its establishment.

Unique Geologic Features: ORCA staff identified the following as unique geologic features in the park:

1. Vermiculations in the carbonate rocks of the cave

2. Flexible flowstone in caves

3. Aplite and quartz dikes exposed in the caves

Scoping Meeting Participants

Tim Connors	Geologist	NPS, Geologic Resources Division
Sid Covington	Geologist	NPS, Geologic Resources Division
Anne Poole	Geologist	NPS, Geologic Resources Division
Ron Kerbo	Cave Specialist	NPS, Geologic Resources Division
Pete Biggam	Soil Scientist	NPS, Natural Resources Information Div.
Chris Currens	Aquatic Biologist	USGS, Biological Resources Division
Marsha Davis	Geologist	NPS, Columbia Cascades Support Office
John Roth	Natural Resources Specialist	NPS, Oregon Caves NM
Deana DeWire	Physical Science Tech	NPS Oregon Caves NM
Tom Wiley	Geologist	Oregon Department of Geology
Daniel Sarr	Network Coordinator	NPS, Klamath Network
Bob Truitt	Data Manager	NPS, Klamath Network
Hanna Waterstat	Data Miner	NPS, Klamath Network

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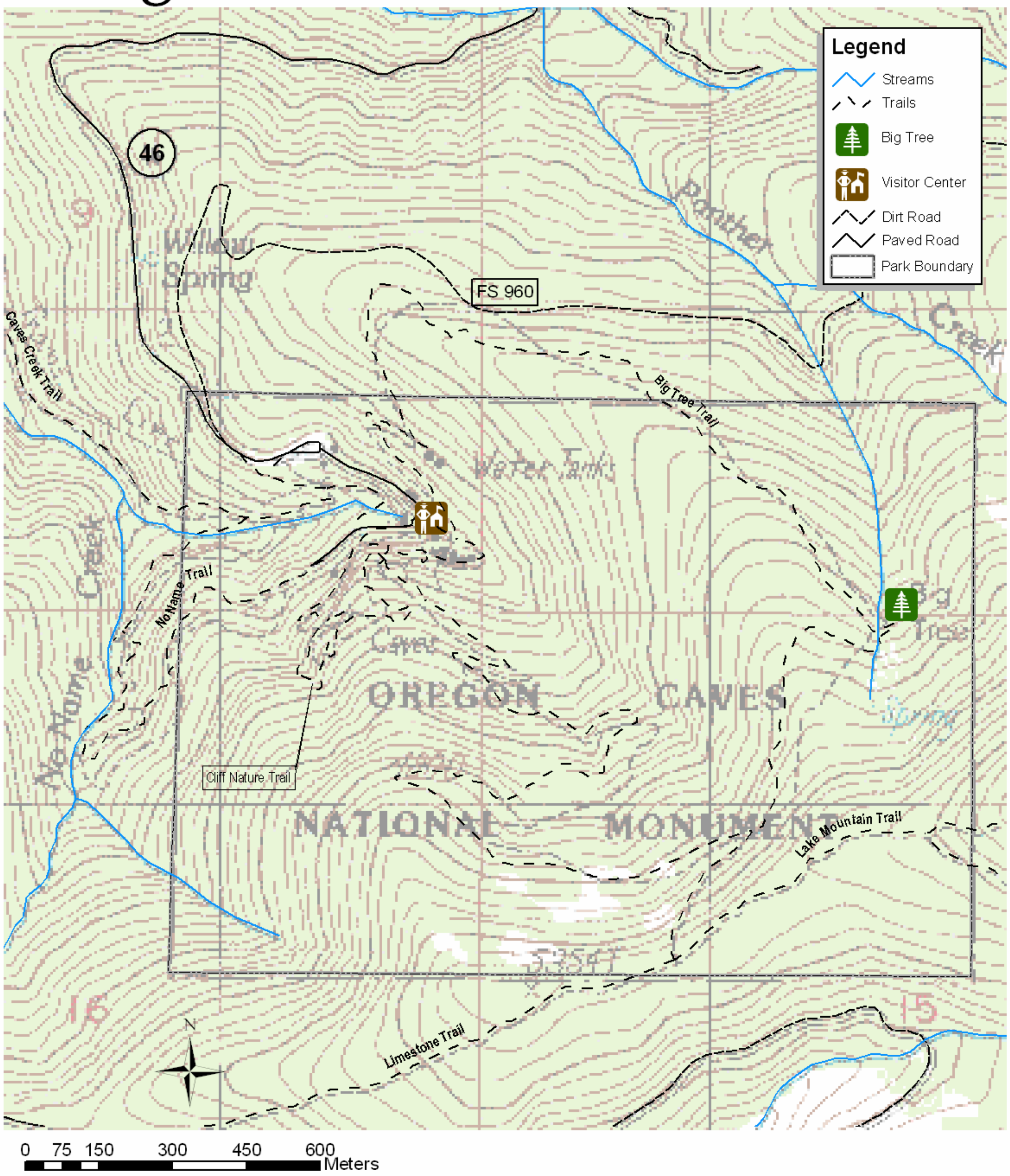
Oregon Caves Trails



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